

Special Report

# **SKUNK RIVER BASIN** ***Iowa***



## **WATERSHED INVENTORY**

Prepared by  
SOIL CONSERVATION SERVICE  
U.S. DEPARTMENT OF AGRICULTURE



**JANUARY 1988**



FRONT COVER - A winter scene of mallard ducks and Canadian geese at Lake  
Ponderosa, Poweshiek County, Iowa

SKUNK RIVER BASIN STUDY

IOWA

WATERSHED INVENTORY

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Conservation Service

January 1988



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## PREFACE

This report was prepared by the Soil Conservation Service (SCS) of the . Department of Agriculture (USDA) at the request of the sponsors of the Skunk River Basin Study. Material herein is based on a study of the potential development of flood damage reduction projects in small watersheds. This information will be useful to water resource planners for recommending watersheds as potential flood damage reduction projects.

The Basin study was conducted under authority of Section 6 of Public Law 85-566, as amended. The law authorizes the Secretary of Agriculture, in cooperation with other federal, state, and local agencies, to make investigations and surveys of the watersheds of rivers and other streams as a basis for the development of coordinated programs.

Sponsors of the Skunk River Basin Study are:

- Skunk River Water Resource District
- Iowa Department of Agriculture and Land Stewardship
  - Division of Soil Conservation
- Iowa Department of Natural Resources
  - Environmental Protection Division
  - Fish and Wildlife Division
  - Forests and Forestry Division
  - Energy and Geological Resources Division
- Geological Survey Bureau

Other special reports in this series prepared during the Skunk River Basin Study are:

- Water Impoundment Opportunities (full report)
- Water Impoundment Opportunities (summary)
- Drainage
- Forest Forage
- Erosion
- Wetlands
- German Creek Watershed Project
- An Overview of Groundwater
- Pesticide Use by Tillage Systems

## INTRODUCTION

The Iowa Division of Soil Conservation (DSC) and the U.S. Soil Conservation Service have responsibilities for promoting and administering the Watershed Protection and Flood Prevention Project (P.L. 566) program in Iowa. These agencies assist sponsoring local organizations in making application for small watershed projects. The governor, through the DSC, sets priorities for servicing applications. A purpose of this phase of the Skunk River Basin Study is to stratify the watersheds in the Basin as to their probable feasibility for flood damage reduction projects.

Data were assembled to indicate: size of flood plain, portion of flood plain used as cropland, frequency of flooding, and availability of sites suitable as retarding reservoirs for each watershed. Integration of this information resulted in rating the watersheds for project feasibility. These ratings are of a comparative nature among all watersheds in this Basin. Economic, social, and political aspects were considered in these ratings. Impacts of construction costs, crop prices, and interest rates are explored in this report. Most of these watersheds are direct tributaries of streams wherein water quality is protected for fish, wildlife, and secondary human contact.

A more detailed flood reduction study was done for one selected watershed German Creek Watershed, a P.L. 566 application area. This watershed investigation did not result in an economically feasible plan; however, data from that study were very useful for evaluating the potential for other watershed projects analyzed in this inventory. Recently planned Soap Creek Watershed in the adjacent Des Moines River Basin was an additional source of comparative data.

## A BRIEF LOOK AT THE BASIN

The basin occupies a relatively narrow corridor extending from the city of Keokuk on the Mississippi River (Figure 1) to the city of Keokuk on the Mississippi River and is 4,652 square miles drained by the Skunk River and its tributaries. This latter portion is the Skunk River Subbasin. Three other hydrologic subdivisions are: the North Skunk River Subbasin, and the Skunk River Subbasin (Figure 6). Physiographic features of the Skunk

River Basin were determined by glacial activity followed by periods of erosion. An upstream area of youthful topography covered by Wisconsin drift contrasts with the downstream area of more mature topography in which the river and tributaries have extensively eroded into older drifts and bedrock.

This Basin is in the Central Feed Grain and Livestock Region 1/ and includes land in three Land Resource Areas (IRA) (Figure 2). In the north is IRA 103, Central Iowa and Minnesota Till Prairies. A large area lies in IRA 108, Illinois and Iowa Deep Loess and Drift. A smaller area of the south part is in IRA 109, Iowa and Missouri Heavy Till Plains.

## STUDY PROCEDURE

### Basic Data

Boundaries, names, and numbers of the Basin, subbasins, and inventory watersheds were taken from maps supplied by the Iowa Division of Soil Conservation. Within each subbasin inventory watersheds had been numbered increasing from the lower end of the subbasin to the upper end. Watershed names generally follow USGS designations of the principal stream name. Flood plains associated with the major streams, i.e. drainage area larger than 250,000 acres were not studied. Also, flood plains at the lower end of tributary watersheds where they are coincident with main stem flood plains were not studied.

District Conservationists provided estimates of flood frequency plain area, land use in the flood plain and other information. incidence of roads and bridges in flood plain hydraulic engineer made a reconnaissance the end of the study SCS River Basin Study personnel visited a sample of seven watersheds conclusions. This report was adjusted the field spot checks.

### Analyses

Field data were tabulated to clear for each watershed (Table 2). Calculations

1/ Atlas of River Basins of the United States  
Soil Conservation Service.

Find the area of flood plain in percent of the watershed drainage area. watershed's flood plain was studied to find the percent used as cropland. Flood plain cropland was also related to drainage area as percent.

All 69 watersheds were delineated on USGS topographic maps and the availability of floodwater retarding structure sites reviewed. The special report, "Skunk River Basin, Iowa, Water Impoundment Opportunities," SCS, 1987, was a frequently used reference. Following are some of the more important criteria used for deciding if a watershed had "Good", "Fair", or "Poor" potential for flood damage reduction through use of retarding structures.

- Storage characteristics indicated by topography
- Spatial distribution of available sites
- Portion of watershed controllable by structures
- Land use within potential structure sites
- Presence of constructed improvements

Structure site ratings were composited for each watershed and listed in Table 2.

Flood control project recommendations were principally based on two parameters: (1) potential for structural control of runoff, and (2) the amount of flood plain cropland as a percent of the watershed drainage area. Potential for "Good" structural control was an absolute must for rating "High" or "Medium" feasibility. Below in tabulated form are criteria used to rate feasibility (Table 1).

Table 1  
RATING CRITERIA  
Skunk River Basin

Flood Project Recommendation Rating	Required Structural Control Potential	Amount of Flood Plain Cropland - Minimum (percent of DA)
High	Good	8.0
Medium	Good	5.0
Low	Good	2.5
Low	Fair	3.5
Very Low	(watersheds not meeting above criteria)	

Table 2  
WATERSHED ANALYZES  
Skunk River Basin  
South Skunk River Subbasin (291)

Page 1 of 4

Watershed Number	Stream Name	Drainage Area (acres)	Size of 1/ Flood Plain (percent of DA)	Flood Plain Cropland 2/ (percent of FP)	Potential 3/ Structures	Project 4/ Feasibility
02	Buckley	24,000	5	85	G	L
03 part	Carson	6,600	6	58	G	L
04	Elk	40,200	10	79	G	H
05	Thunder	19,000	9	57	G	M
06	Cherry	25,700	7	47	G	L
07	Prairie	16,400	10	54	G	M
09	Indian (lower)	60,500	15	71	P	VL
10	Clear	53,900	8	73	G	M
11	Indian (upper)	140,200	1	55	P	VL
12	Calamus	9,700	1	93	P	VL
13 part	Ballard	18,500	2	69	P	VL
13 part	White Oak	6,700	3	3	G	VL
14	Walnut	12,80	1	62	P	VL
15	Drain #13	8,40	2	89	P	VL
16	Squaw	145,50	4	15	P	VL
17	So. Skunk (lower)	28,60	1	34	P	VL
18	Keigley	29,90	2	22	P	VL
19	Bear	20,30	2	35	P	VL
20	Long Dick	21,30	2	40	P	VL
21	So. Skunk (upper)	41,90	2	38	P	VL
22	Rahto	53,70	2	50	P	VL

Table 2  
WATERSHED ANALYZES  
Skunk River Basin  
Skunk River Subbasin (292)

Page 2 of 4

Watershed Number	Stream Name	Drainage Area (acres)	Size of 1/ Flood Plain (percent of DA)	Flood Plain (percent of FP)	Cropland 2/ (percent of DA)	Potential 3/ Structures	Project 4/ Feasibility
01 part	Long	13,800	5	0	0	F	VL
01 part	Cedar	10,200	4	5	.2	G	VL
01 part	Mud	10,900	1	66	.9	F	VL
02	Big	106,900	2	62	1.2	P	VL
03	Fish	16,500	1	42	.5	F	VL
04 part	Mud	11,400	2	75	1.8	G	VL
04 part	Sugar	12,500	4	44	1.6	G	VL
05	Cedar (lower)	74,100	1	60	.8	P	VL
06	Wolf	19,000	3	54	1.7	G	VL
07	Little Cedar	35,600	2	42	1.0	G	VL
08	Cedar (upper)	176,000	6	68	4.3	P	VL
09	Crow	13,100	4	58	2.1	G	VL
10	Coon	20,000	4	60	2.5	G	L
11	Competine	24,300	4	65	2.5	F	VL
12	Brush	22,500	5	56	2.9	G	L
13	Walnut	57,200	3	63	1.8	G	VL
16	Crooked	182,700	5	-	-	-	-

Watershed Number	Stream Name	Drainage Area (acres)	Size of 1/ Flood Plain (percent of DA)	Flood Plain Cropland 2/ (percent of FP)	Potential 3/ Structures	Project 4/ Feasibility
01 part	Unnamed (E. of German)	7,500	1	92	F	VL
02	German	35,800	5	75	G	L
03	Bridge	24,900	7	46	G	L
04	Cedar	27,400	7	55	G	L
05	Rock	17,600	6	41	G	L
06	Coal	14,100	5	44	G	VL
			6	28	G	VL
			9	72	G	M
			)	79	F	L
			)	44	G	L
			3	94	F	VL
			9	84	G	M
			2	54	G	VL
			3	60	G	VL
			5	58	G	L
			2	73	G	VL
			5	74	G	L
			5	70	G	L
			5	76	G	L
			6	67	F	L
			5	70	G	L

Table 2  
WATERSHED ANALYZES  
Skunk River Basin  
Sugar Creek Subbasin (310)

Watershed Number	Stream Name	Drainage Area (acres)	Size of 1/ Flood Plain (percent of DA)	Flood Plain (percent of FP)	Cropland 2/ (percent of DA)	Potential 3/ Structures	Project 4/ Feasibility
01 part	Jack	9,000	2	22	.5	G	VL
01 part	Lamalees	6,500	4	7	.3	G	VL
03	Sugar	103,900	4	32	1.4	F	VL
04	Lost	24,600	7	28	2.0	F	VL

1/ Size of flood plain is listed in percent of drainage area.  
2/ Amount of cropland is listed in percent of flood plain area and in percent of the watershed drainage area.  
3/ The potential for structural flood control was rated for each watershed. G = Good, F = Fair, P = Poor.  
4/ This recommendation column shows the result of evaluating the amount of cropland as a percent of drainage area and the potential for structural flood control. H = High, M = Medium, L = Low, VL = Very Low.

Table 3  
SUMMARY OF PROJECT FEASIBILITY  
Skunk River Basin

basin	Number of Watersheds by Feasibility Rating				Total
	Very Low	Low	Medium	High	
North Skunk River	14	3	3	1	21
Skunk River	20	3	0	0	23
South Skunk River	7	12	2	0	21
Elk Creek	4	0	0	0	4
TOTAL	45	18	5	1	69

#### RESULTS OF INVESTIGATIONS

Applying Table 1 criteria results in 45 watersheds rating "Very Low", 18 rating "Low", only five rating "Medium", and one rating "High" feasibility for flood damage reduction projects (Table 3). Following the field review one inventory watershed, Elk Creek Watershed, number 04 in the South Skunk River subbasin, was rated "High" for project feasibility. This watershed not only meets criteria requirements for the "High" rating but also exceeds the "Medium" rated watersheds by showing stronger evidence of more frequent flooding, a more level flood area, and a more consistent, uniform topography and land use throughout the flood area. Therefore, Elk Creek Watershed was selected as the only "High" feasibility watershed.

Watersheds rating "Medium" are in the South Skunk and North Skunk subbasins and are centrally positioned in the Basin (Figures 3 and 5) (Table 3). These five "Medium" feasibility watersheds are all "left bank" (looking downstream) tributaries with one exception, Middle Creek Watershed, a "right bank" tributary of the North Skunk River in Mahaska County.

Reduction of sedimentation is a flood prevention benefit. All six watersheds with "High" or "Medium" project feasibility ratings are direct tributaries of streams rated B(W). These are warm water streams protected for fish, wildlife, and secondary human contact. Structures placed in these watersheds would provide downstream benefits to water quality values.

There are 16 lakes with over 40 acres surface area in the Skunk River Basin. Most of these lakes are for public use. Some have sediment basins

constructed on inlets to enhance water quality.

In 1967 an analysis of inventory watersheds was done state-wide to estimate project feasibility. The summary publication 1/ does not differentiate between "flood prevention" and "drainage" watershed projects. Thirty watersheds in the Skunk River Basin were declared feasible for projects. Several were for "drainage" only, based upon knowledge of those watersheds. Watersheds receiving a "High" or "Medium" potential in this current study that were also declared feasible in the Conservation Needs Inventory are:

Elk Creek, Newton County  
 Clear Creek, Story, Marshall, Jasper Counties  
 Middle Creek, Mahaska County  
 Sugar Creek, Jasper, Poweshiek Counties

Table 4  
 WATERSHEDS WITH "HIGH" OR "MEDIUM" PROJECT FEASIBILITY  
 Skunk River Basin

Watershed Number	Project Feasibility	Stream Name	County
<u>South Skunk River Subbasin</u>			
04	High	Elk Creek	Jasper Marion Mahaska
05	Medium	Thunder Creek	Marion
07	Medium	Prairie Creek	Jasper
10	Medium	Clear Creek	Story Marshall Jasper
<u>North Skunk River Subbasin</u>			
08	Medium	Middle Creek	Mahaska
13	Medium	Sugar Creek	Jasper Poweshiek

1/ Iowa Conservation Needs Inventory, Iowa Conservation Needs Committee, 1970.

## REVIEW OF GERMAN CREEK WATERSHED

German Creek Watershed (Number 02 in the North Skunk River Subbasin, are 5) lies east of Sigourney, Iowa. The Keokuk County Soil and Water Conservation District (SWCD), the Keokuk County Board of Supervisors, and the Keokuk County Conservation Board applied for assistance in German Creek Watershed through P.L. 566 in October 1971. One of several soil and water resource problems cited was flooding of cropland and roads. During this recent Skunk River Basin Study a preauthorization planning investigation for German Creek Watershed was completed. Potential for P.L. 566 project action was studied for flood damage reduction and for accelerated land treatment. This summary addresses conclusions regarding feasibility for a flood damage reduction project.

Investigations determined the extent of flood damages through personal interviews, examination of flood records, and by hydrologic and economic studies. Flood plain and channel cross-sections were surveyed at 18 stations. Potential floodwater retarding structures were located at 13 sites (figure 7). Flood reduction was investigated through use of floodwater retarding structures only. The 13 structures were tested in eight combinations (alternatives) to determine physical effects upon flooding and economic feasibility.

The 100-year flood plain area is 1,760 acres. Total without-project average annual flood damage is estimated at \$168,100. This amount is a sum of \$50,500 crop and pasture damage, and \$17,600 other agricultural and road and bridge damage. All eight with-project alternatives reduce flood damage. However, cost estimates for each of the structural plans exceed benefits under present installation costs, interest rates and crop prices. Studies were done during fiscal year 1986 and for fiscal year 1977 for Alternative Number Three which structures would control 31 percent of flood damages 40 percent. Increasing drainage area with 10 structures would result in a benefit:cost ratio of 0.60. German Creek Watershed is not a feasible project at present.

Under the inventory group analysis described earlier in this report, German Creek Watershed has "Good" potential for retarding structure sites and "Low" feasibility as a flood reduction project due to there being only 10 percent of flood plain cropland with respect to drainage area (Table Sheet 3).

### CONCLUSIONS AND RECOMMENDATIONS

Potential for feasible flood damage reduction projects in 69 inventory watersheds of the Skunk River Basin has been analyzed. This study reviewed physical characteristics of these watersheds including: amount of flood cropland, and the availability and quality of retarding structure sites. Six inventory watersheds were distinctively set apart as having "High", "Medium", or "Low" potential for flood damage reduction projects. There is no need that under current conditions these watersheds would be feasible when studied in detail. This study did stratify the watersheds as to their probability of being feasible (Table 2). Therefore, the ratings provide planners with a guide for selective allocation of limited planning funds and manpower. The value of these comparative ratings will be useful until significant physical changes occur in the watersheds, or there are changes in planning criteria. Scenarios at which flood damage reduction projects for inventory size watersheds seem to become economically feasible follow below (Table 5). Conclusions stem from the German Creek Watershed preauthorization planning

Table 5  
FEASIBILITY SCENARIOS  
Skunk River Basin

Scenario	Installation Cost (1986 base)	Interest (percent)	Crop Price	
			Corn (dollars per bushel)	Soybeans (dollars per bushel)
A	Little change	8.5	3.20	7.00
B	Little change	7.5	2.80	5.70
C	+ 10 percent	8.5	3.70	7.30
D	+ 10 percent	7.5	3.20	7.00

investigations discussed above and from Soap Creek Watershed studies in the lower Des Moines River Basin. Soap Creek Watershed has a recent project plan for flood damage reduction. The favorable benefit:cost ratio for that project

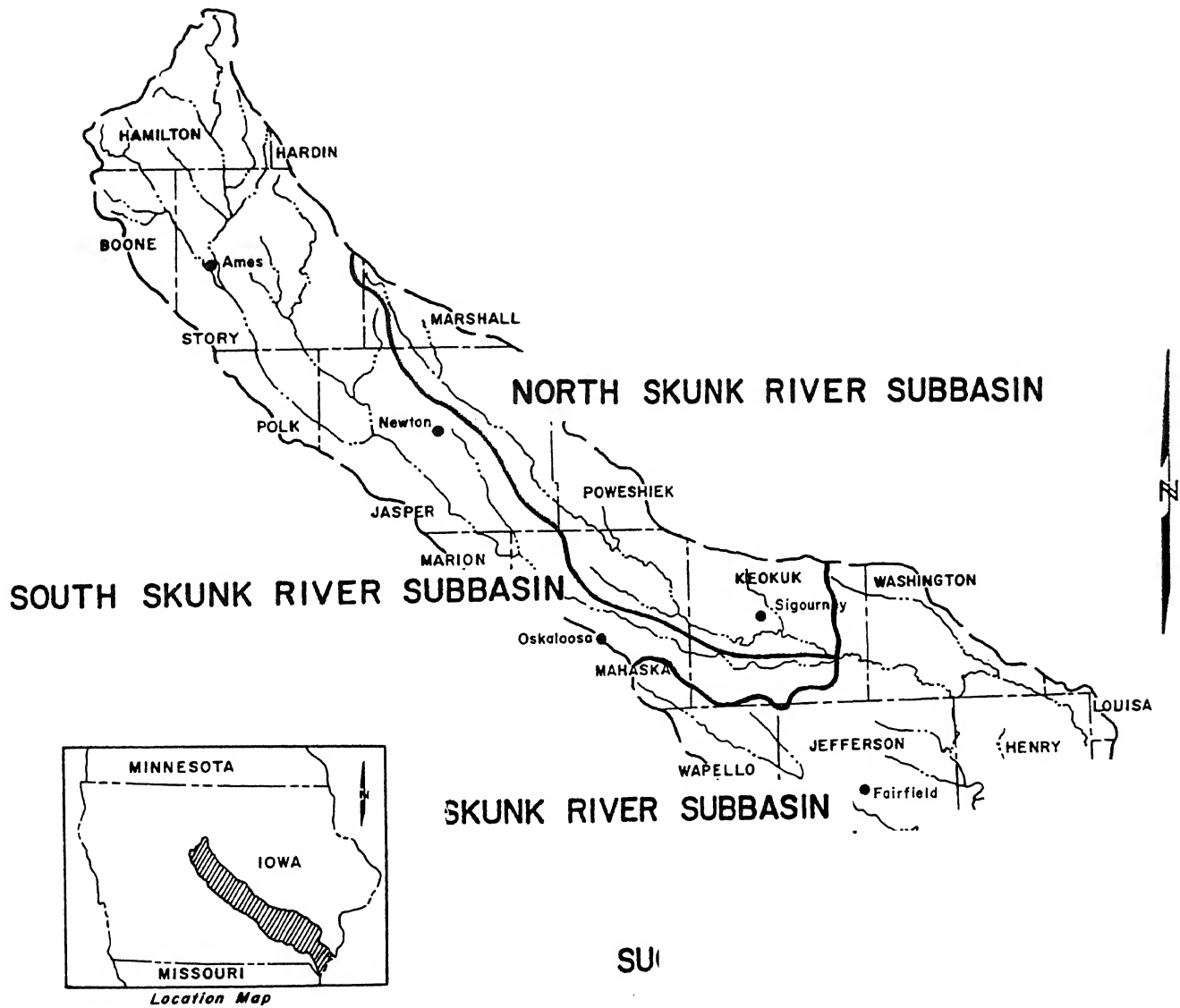
is from good structure sites, large amount of cropland in the flood plain, large pre-project flood damage from sedimentation, scour, roads, bridges, other property.



# LOCATION MAP

## SKUNK RIVER BASIN

### IOWA



Figur



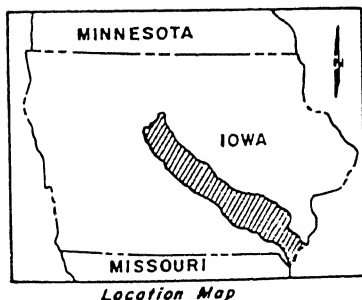
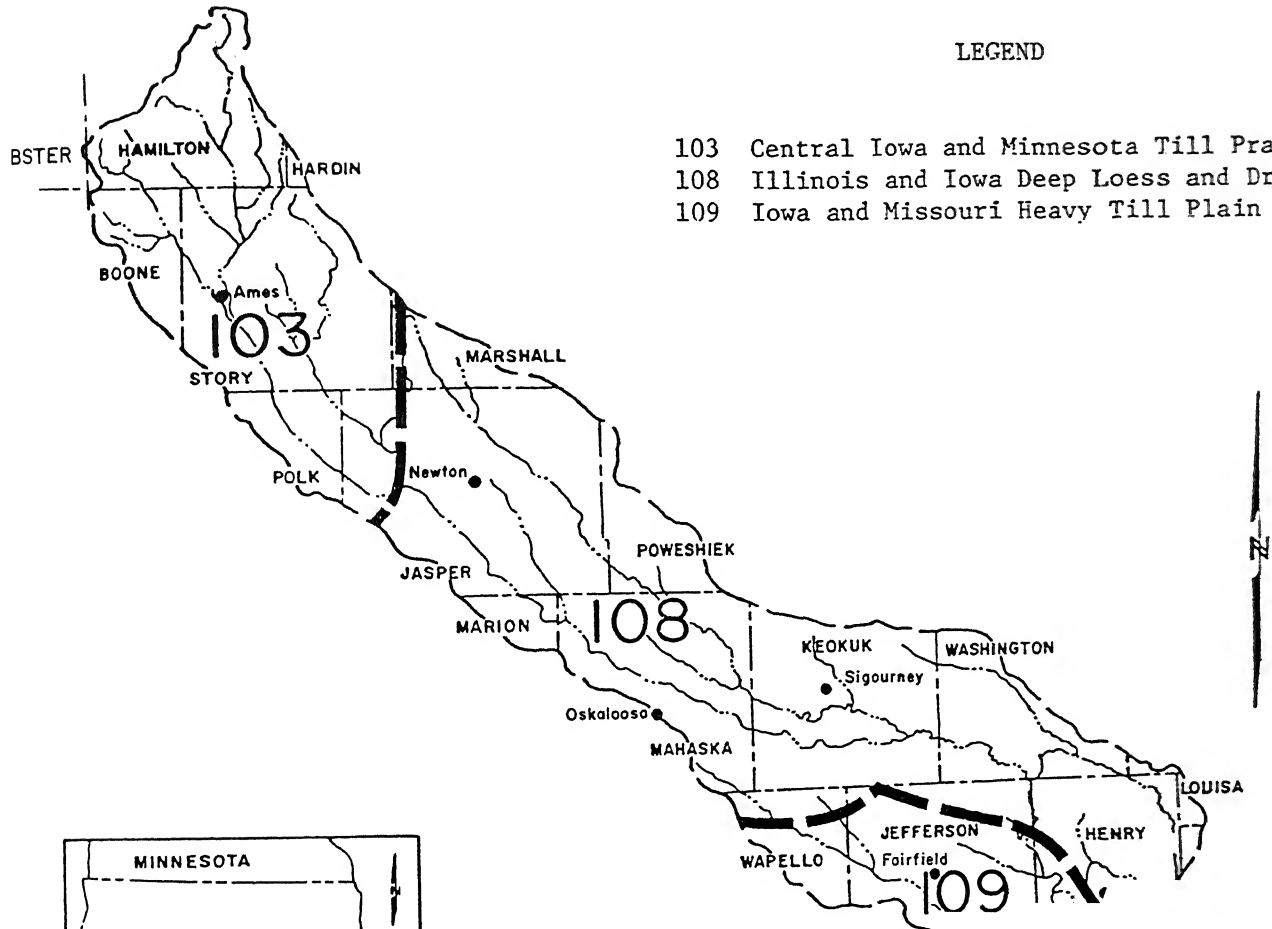
# LAND RESOURCE AREAS

## SKUNK RIVER BASIN

### IOWA

#### LEGEND

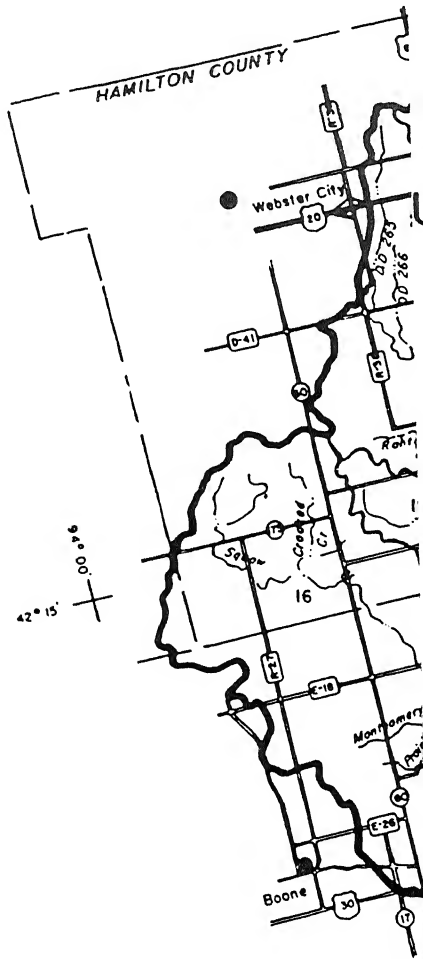
- 103 Central Iowa and Minnesota Till Prairies
- 108 Illinois and Iowa Deep Loess and Drift
- 109 Iowa and Missouri Heavy Till Plain



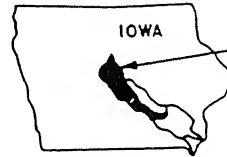
Location Map







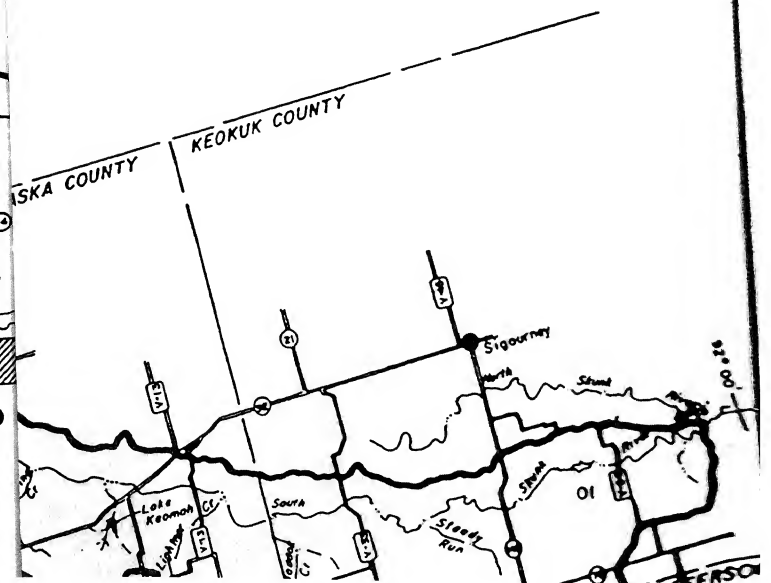
## SUBBASIN (291)



SOUTH SKUNK  
RIVER SUBBASIN

### LEGEND

- SUBBASIN BOUNDARY
- WATERSHED BOUNDARY
- COUNTY BOUNDARY
- HIGHWAY
- WATERSHED NUMBER
- RESERVOIR AND STREAM
- TOWNS OVER 15,000
- COUNTY SEAT



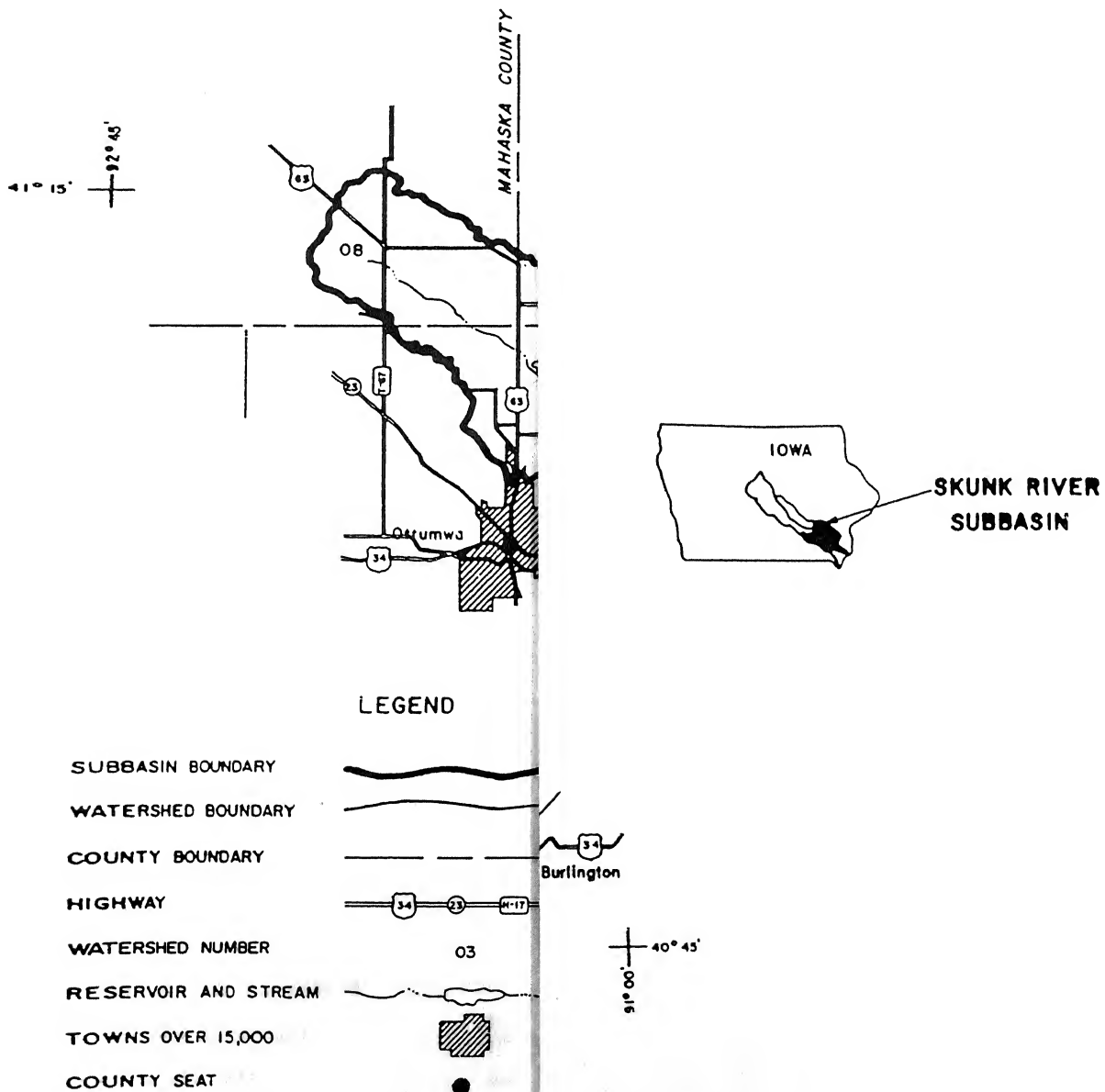
SOURCE : USGS, USCG, AND USCE 1/250,000 BASE MAPS,  
WITH REFERENCE TO IOWA COUNTY HIGHWAY MAPS  
DRAWN BY SOIL CONSERVATION TECHNICIAN, IOWA  
DEPARTMENT OF SOIL CONSERVATION



IRE 4

WER SUBBASIN (292)

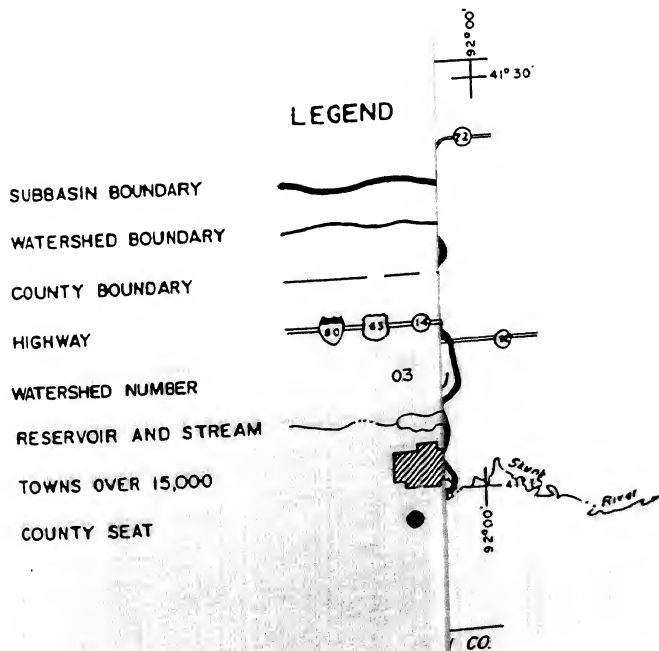
OWA



USGS, USCG, AND USCE 1/250,000 BASE MAPS,  
WITH REFERENCE TO IOWA COUNTY HIGHWAY MAPS  
DRAWN BY SOIL CONSERVATION TECHNICIAN, IOWA  
DEPARTMENT OF SOIL CONSERVATION



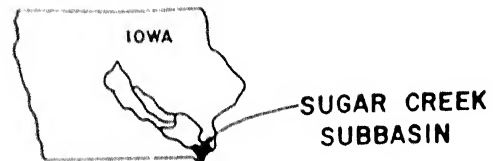
# UBBASIN (300)



SOURCE : USGS, USCGS, AND USCE 1/250,000 BASE MAPS,  
WITH REFERENCE TO IOWA COUNTY HIGHWAY MAPS  
DRAWN BY SOIL CONSERVATION TECHNICIAN, IOWA  
DEPARTMENT OF SOIL CONSERVATION



FIGURE 6  
CREEK SUBBASIN (310)  
IOWA



## LEGEND

SUBBASIN BOUNDARY	
WATERSHED BOUNDARY	
COUNTY BOUNDARY	
HIGHWAY	
WATERSHED NUMBER	03
RESERVOIR AND STREAM	
TOWNS OVER 15,000	
COUNTY SEAT	

SOURCE: USGS, USCGS, AND USCE 1/250,000 BASE MAPS,  
WITH REFERENCE TO IOWA COUNTY HIGHWAY MAPS  
DRAWN BY SOIL CONSERVATION TECHNICIAN, IOWA  
DEPARTMENT OF SOIL CONSERVATION



# STRUCTURE SITES GERMAN CREEK WATERSHED Skunk River Basin, Iowa

